[U.S. Department of Health, Education, and Welfare, Public Health Service, Presents]
[Mammography Technique]
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[Dr. Egan:]
In women, the breast is the most common site of cancer.
The incidence is higher than that of all the malignant neoplasms of the reproductive organs combined.
In the United States, 68,000 new cases are discovered annually.
[Line graph of cancers of uterus and breast shown]
There are 24,000 deaths from cancer of the breast yearly.
One of the most striking facts in medicine is that the salvage rate of cancer of the breast has maintained a plateau for the past several decades as shown by the nearly straight line in this graph, while in other areas of medicine there have been remarkable advancementsas indicated by the dipping line showing a decrease in the death rate from cancer of the uterus.

Mammography is a radiographic exploration of the breast.
[Slide stating Mammography is soft tissue roentgenography of the breast, No air...No opaque material...]
It is a safe, reliable, and aesthetically acceptable method of diagnosis of breast diseases in their early stages.
Mammography requires no special equipment, and demands only meticulous attention to radiographic technique.
Mammography is not new.
[Saloman, 1913, Warren, 1929]
Salomon in Germany in 1913 used x-rays to study his breast specimens.
Stafford L. Warren in New York is credited with being the first to apply these procedures clinically in 1929.
[Leborne, Gershon-Cohen]
Leborgne of Uruguay and Gershon-Cohen of the United States have more recently described the examination.
In the spring of 1956, I was asked to do mammography at the University of TexasM.D. Anderson Hospital and Tumor Institute in Houston, Texas.
Published techniques gave poor results in my hand. As a matter of fact, after talking to a number of the earlier workers in mammography, I found that the procedure had fallen into disuse due to the erratic results obtained with poor quality roentgenograms.
A wide range of technical factors was investigated prior to adoption of our mammographic technique utilizing equipment in the average radiology department having only one variable -that of target skin distance and delivering consistently highly diagnostic mammograms.

[Animated image of a machine expelling a cloud that reads Low KVP, High MA, 6 sec., Close Collimation, fine-grain Film, No Filter, Variable Target-Film, Distance]
We suggest you master this basic technique.
Do it for 100 or 1,000 cases.
Then experiment when you are aware of how much detail is being sacrificed.
We shall not be concerned at this time with minor variations of the basic technique.
All such variations have been tried and found non-rewarding.
Presently, we are concerned with emphasizing the need for maximum roentgenographic detail in mammography.
Diagnosis will be the subject of a future program.
Technique is 90 percent of the procedure, with interpretive ability ten percent.
Historical evaluation as well as our own experience bears this out.

A procedure previously tried and discarded in our institution immediately became enthusiastically endorsed as a routine procedure when the clinicians were presented with a technique of excellent detail.
The sine qua non is a film of good detail.
And this requires proper coning, fine-grain emulsion, low kilovoltage, high miliampage.

[Slide reading Proper Coning, Fine-Grain Emulsion, Low KVP, High MAS]
The technique utilizes only one variable - distance. And this compensates for the wide range in size and density in the various breasts.
The full examination requires three views:

[Slide reads Routine Views, Craniocaudad, Mediolateral, Axillary] the craniocaudad view, the mediolateral view, and the axillary view. Usually the first two views can be included on the five-by-eight half of an eight-by-ten film.
With the help of our Chief MammographyTechnologist, Ms. Evelyn O'Donnell, and our model, we shall run through the procedure of mammography.
Detailed facts and factors of the technique will be gladly supplied upon request.
We also suggest that you spend some time at one of our teaching centers or with an experienced mammographer to polish your technique.
A cylinder collimator is necessary to achieve good detail.
An adjustable diaphragm type of cone is not adequate and must be replaced.
Any added tube filtrations must be removed.
Thus, the examination is done with the use of only inherent tube filtration.
Most cones with adjustable diaphragms have one-half to one millimeter equivalent aluminum filter in the light localizer. Thus, requiring removal.
Fine-grain emulsion with adequate contrast range must be used to record detail of one-tenth millimeter size objects studied by mammography. Very fine-grain industrial types have been found most suitable.
It is used in a cardboard holder. The slight stiffness of the cardboard as opposed to paperbacks makes positioning easier with the exclusion of skin wrinkles and air pockets.
The kilovoltage setting is one which, at 36 inches with the proper coning,just allows penetration of the 15 millimeter aluminum wedge at a setting of 300 milliamperes at six second.
This kilovoltage is in the neighborhood of 26.
Inspection of the roentgenograms of the wedge allows final adjustment of the kilovoltage.
This will be your setting for the craniocaudad view. Simply increase two KVP for the mediolateral view.
If the mammogram is too light, go up 2 KVP on your average setting.
If too dark, go down two KVP.
It is the film effect and reproducibility which is important.
Not the exact KVP used.
Some modifications of the existing x-ray equipment may be necessary to achieve the low KVP and high MAS necessary.
For instance, a bypass to the safety control switch or additional taps from an auto transformer to get the required low kilovoltage.
It is suggested that you check carefully your tube heating and cooling chart and figure as though you were getting full MAS delivered.
This will be a large safety factor as there is electron fog and fulfillment and full MAS is not truly delivered. Set the KVP as low as possible and work up.
May even start with three-second exposures to make sure this does not totally blacken your film and overload the tube.
We may now proceed with positioning of the patient.
It is of extreme importance that the patient is reassured and relaxed.

She is seated comfortably at the end of a table, adjustable in height, or an adjustable stool that may be used in combination with a fixed table.
The film is placed flat on the table.
The cardboard holder, as you just saw, is elevated as high as comfort permits with its edge pressed against the chest wall.
With the breast placed on the film, half the film is protected by a lead shield and will be used for the craniocaudac view of the other breast. An added sandbag adds stability.
Relaxation and dropping of the shoulder prevents the clavicle from obscuring the base of the breast.
The nipple must be exactly in profile; that is. tangential to the x-ray beam.
The extreme periphery of the breast will not be included in the craniocaudac view.
This, however, is of no great concern as these areas will be well-projected on the mediolateral view.
The identification marker is placed face up on the axillary portion of the film so it can be read from above.
If this is always done, the breast can be identified not only as to the superior or lateral aspect,but also to the correct breast.
The head is turned to the contralateral side.
The tube is then swung into place.
As you note, the cone will be close to the patient's face.
The tube is then raised or lowered until the beam covers the breast with a margin of about one inch.
Some estimate of required target film distance may previously be obtained by exposures of roentgenograms or with the use of the filament glow of this non-filtered beam in the subdued light.
A central beam is directed to the midpoint of the base of the breast and parallel to the chest wall.
The more energetic central beam traverses the thickest portion of the breast.
With fall-off toward the periphery of the breast, a homogeneous density on the mammogram is thus produced.
If it is desired to study any point of interest on the film more fully, the distance can be decreased for more detail study of appropriate regions of the breast.
As demonstrated here, the value of the extension cone is apparent.
The extended cone, by improved collimation, compensates for the increased MAS from the decreased target film distance.
As a further modification, compression can be used.
In practice it is rarely found to be necessary and does require additional gadgetry.
This is a finished product.

[An x-ray image of the breast is shown.]
Note the irregular density in the breast just beneath the areola [?]
To review the technical factors for the craniocaudad view: there is no added filtration.
We must use proper coning, six-second exposure, industrial fine-grain type film emulsion, cardboard holder, 26 kilovoltage, 300 MA, and just sufficient distance to cover the breast, usually ranging from 22 to 40 inches.

[Slide listing Technical X-ray factors for craniocaudad view, No added filter, Proper coning, 6 esconds, 4. Kodak 'M' type, 5. Cardboard holder, 6. 26 K.V., 7. 300 M.A., 8. Distance to cover breast (22" to 40")]
The mediolateral view provides the second projection of the breast.
If one view could be considered the most important, this would be it.
Also, apparently, it is technically more difficult to master.

The patient is recumbent with her arm relaxed as shown, her head on the pillow.
The film is tucked snugly along the chest wall with the patient in the posterior-oblique position.
A wooden block is used to support the film. This block is three inches thick.
It is important to eliminate skinfolds.
This is best accomplished by elevating the breast and carefully placing the flexible cardboard holder to follow snugly the chest wall and lateral surface of the breast.
The patient is then adjusted toward the lateral position, if necessary, while keeping the breast in good contact with the film holder.
This ensures that even a small breast is seen in profile.
The breast should by supported purely by the wooden block.
Not suspended from the chest wall.
With such support and suspended respiration, motion is of no greater problem than in radiography generally.
The nipple, as shown, is in profile.
Half the film is masked and kept in position by a lead shield, and if necessary, an added sandbag.
The central bream is directed to the base of the breast.
A small portion of the rib cage is included.
This ensures complete coverage of the breast.
The tube is positioned so that the breast is projected on the film plus a border of approximately one inch.
The patient is relaxed and comfortable.
If a pendulous, opposite breast interferes, it should be retracted.
The retracting arm and fingers should be comfortably placed, not with the elbow elevated nor with the wrist and fingers strained.
Pendulous breasts require more care and prevention of skinfold being interposed between the breast and the film holder.
Now, we shall repeat the positioning of the mediolateral view, so that we can emphasize these several points again.
As already mentioned, this is the view that generally causes greatest difficulty in positioning.
This can be seen when the curve set is placed along the chest wall.
The patient moves into the lateral position.
The nipple is nearly in profile.
The tube is then brought into position.
The opposite breast is retracted if necessary. Very gently retracted.
The identification marker is placed on the axillary portion of the film, readable from above.
Cone-down views may be obtained to demonstrate questionable areas to better advantage.
Here again, the extension-type cylinder cone is of great value.
You see extending the cone, if you'll note, there are several markers on the cone.
These may be conveniently placed for estimation of the area to be covered.
There is no significant diagnostic difference in the normal mediolateral view as compared with the craniocaudad.
However, with only a single view, a cancer such as indicated by the arrows here cannot be localized.

[An x-ray image of a breast with an up arrow and a down arrow pointing toward a spot on the film is shown.]
It was not evident clinically.
A second view at right angles is required for quadrant localization.
The only change in technical factors for the mediolateral view is an added two KVP or the setting of 28 KVP.
No added filtration, proper coning, six seconds, industrial-type film, cardboard holder, 28 KV, 300 MA.

[Slide indicates technical X-ray factors for craniocaudad view, No added filter, Proper coning, 6 esconds, 4. Kodak 'M' type, 5. Cardboard holder, 6. 26 K.V., 7. 300 M.A., 8. Distance to cover breast (22" to 40")]
Again, the only variable is the change in target film distance so that the breast is properly included in the x-ray beam.
This usually varies from 22 to 40 inches as on the craniocaudad view.
Respiration is suspended during each exposure.
The third view taken to complete the mammographic study is the axillary view.
The patient is recumbent.
The entire eight-by-ten film is placed in position.
With a contralateral forearm and hand placed comfortably over the abdomen.
The ipsilateral arm is at a right angle to the trunk with the elbow flexed.
Abduction must not be more that 90 degrees.
Further abduction causes a scapula to be superimposed over the axilla.
Nor should it be less than 90 degrees.
Further abduction causes skinfolds to be superimposed over the axilla.
The patient is then rolled into approximately 30 degrees oblique position.
The x-ray beam is centered to a point approximately five centimeters below the apex
of the axilla with the eight-by-ten inch film centered to the central beam.
The breast hangs freely.
The target film distance is 40 inches for the average patient.
In the obese, increased penetration is achieved by decreasing the distance to 30 inches.
Not by increasing the kilovoltage.
With this shorter distance, the centering point is just below the apex of the axilla.
An identification marker is placed, as on the other view.
On the roentgenogram of the axilla can be seen the ribs, humeral head, muscular plains of the axilla, and the retro-mammary space.
The breast may be distorted in appearance since it is not supported.
These technical factors arise from the use of the lowest KVP possible for penetration of the normal axillary tissue.

[Slide indicates Technical X-ray factors for craniocaudad view: No added filter, Proper coning, 3 1/2 esconds, 4. Kodak 'M' type, 5. Cardboard holder, 6. 54 K.V., 7. 300 M.A., 8. Average size 40" obese 30"]
They are: No added filter, proper coning, three and one-half seconds, industrial type film, fine-grain, cardboard holder, 54 KVP, 300 MA, and the average patient's target film distance is 40 inches and in the obese it is reduced to 30 inches.
In the obese as noted, the target film distance is reduced to 30 inches covering less area as indicated on the mammogram on the left of your screen.
This is in comparison with the area covered by the usual 40 inch-distance mammogram on the right of the screen.

[Dose Rate for Mammography (Average Factors) Roentgenogram, Cranioclaudad, Mediolateral, Three views, Given Dose, 2.4 R (skin), 2.8 R (skin), 3.3 R (mid point breast)]
With any new roentgenographic procedure, dosage rates must be established.
From the average exposure during mammography, the skin receives with back scanner, 2.4 and 2.8 are as shown in the craniocaudal and the medial lateral views.
The total dosage to the midpoint in the average breast for the three exposures is 3.3R. This dose is considered safe.
Careful processing of the film is required.

[Slide indicates Developing Time 8 Min. at 68 degrees F, Fixing time, 10 Min. Plus]
Developing time of up to eight minutes at 68 degrees Fahrenheit with fixing time of ten minutes or more are necessary.
A hand magnifying lens is an indispensable aid in viewing the mammograms.
The detail on the roentgenogram is so fine the structure is not appreciated with the naked eye; and will be appreciated by magnification with this lens.
Certain areas of the mammogram may require bright light for optimal viewing.
Mammography is not to replace physical examination or biopsy.
But with good technique, it is a highly accurate procedure.
The most important single aspect of a mammography is roentgenographic detail.
A couple of examples may serve to illustrate the necessity of good mammograms.
The first one, shown here with numerous flecks of calcification best seen in the region of this arrow,is of a patient who came in complaining of pain in her opposite breast.
These typical calcifications of cancer were revealed on the - by a mammography in a clinically normal breast.
This next patient is that of a rather obese lady who came into the institution with vague breast complaints.
The breasts were clinically normal.
However, with mammography we see in the upper portion of the breast near its base a two-centimeter definite carcinoma.
Our third patient is one who had a clinically suspicious nodule in her breast seen in the central portion of the breast in this mammogram, which was quite clearly carcinoma by mammography.
However, in the superior and somewhat anteriorly to this mass was a half-centimeter irregular density.
A second carcinoma within this breast not appreciated clinically.
In the opposite breast there was also a central small lesion approximately six millimeters in size.
This illustrates the value of a mammography in which we have a suspected carcinoma in one breast, we find a second carcinoma in this breast, and a third carcinoma in the same patient in the opposite breast.
Two clinically unsuspected carcinomas in the one patient.
This is extreme value in treatment planning.
I would like to point out that with mammography we have the opportunity to find breast cancers earlier with better prognosis.
Hopefully to change that plateau of survival referred to earlier.
Mammography is nothing but roentgenography based on well-established principles.
One good mammogram surpasses dozens of poor ones.
My suggestion is aim to maintain or improve mammographic detail.
Not attempt shortcuts that may detract from that detail.
As mammography will only find its full value if others duplicate and use it.

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